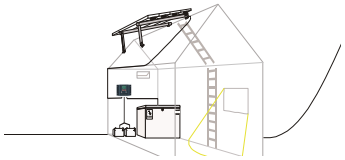
DULAS Solar Powered

VC150 Refrigerator/Freezer

Installation & Operation Manual

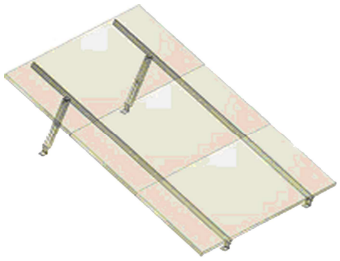
June 2010

CONTENTS



KNOW YOUR SYSTEM

SECTION	Page
Component checklist	3
Battery safety	4
Preparation	5
Completed system	6



SOLAR ARRAY

Photovoltaic module assembly	7
Support structure orientation	8
Support structure assembly	10
Lightning protection	12

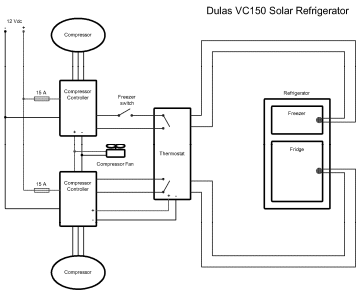
ELECTRICAL SYSTEM

Photovoltaic controller information and installation	13 - 18
Battery commissioning	19

THE REFRIGERATOR / FREEZER

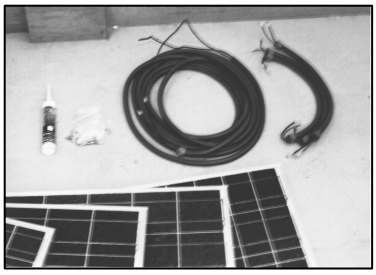
Positioning and starting	20
Loading	21
Fridge temperature controller	22 - 24
Appendix A: technician's instructions	25
Routine maintenance	26 & 27

SYSTEM DIAGRAMS



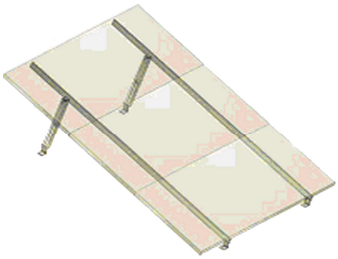
Photovoltaic module and battery layouts	28
System wiring diagram (Version 1)	29
System wiring diagram (Version 2)	30
General layout diagram	31
Electrical Schematic	32
Refrigeration circuit diagram	33

COMPONENTS – CHECK LIST



REF	PRODUCT	QUANTITY
	SOLAR ARRAY (either 270W or 405W)	
a. 1	KD135 Solar Modules	2 or 3
a. 2	10m Array Output Cable	1
a. 3	0.5m Module Interconnect Cable Assembly	1 or 2
a. 4	Bolt, Plain Washer, Nylon Washer, Penny Washer & Nut	Pack
a. 5	Silicon Sealant	1

	REFRIGERATOR	
b. 1	DULAS VC150 Refrigerator / Freezer	1
b. 2	4m Refrigerator Cable	1



	SUPPORT STRUCTURE	
c. 1	Unirac rail kit	2
c. 2	Unirac high profile tilt leg kit	2
c. 3	Feet	4
c. 4	Bolt, Plain Washer, Spring Washer & Nut	Pack
c. 5	Screws & Wall Plugs	Pack
c. 6	Cable Clips	Pack

	BATTERY PACK	
d. 1	Battery	2
d. 2	Battery box	1
d. 3	Photovoltaic controller	1
d. 4	Battery to controller cable	1
d. 5	Spare Fuses	Pack
d. 6	Cable Ties	5
d. 7	Padlocks	3

TOOLS REQUIRED FOR INSTALLATION

Pozidriv No.2 Screwdriver	Slot-head Screwdriver
Pliers	Wire Cutters
Wire Strippers	Craft Knife
Drill and Bits	Hammer and Punch
Adjustable Spanner	Size 10, 11, 13, 14 & 17 mm Spanners

BATTERY SAFETY

Observe operating instructions and position them within sight of the battery! Work only on batteries under instruction of skilled personnel!

The electrolyte (diluted sulphuric acid) is extremely corrosive
When working on batteries wear safety glasses and protective clothing!

Acid splashes in the eyes or on the skin must be washed out or off with plenty of water. Then see a doctor immediately. Clothing exposed to acid should be washed out with water without delay.

Electrical Danger! In the case of a short circuit, extremely high currents can occur which can cause severe burns.

Block batteries or cells are heavy! Ensure secure installation! Only use suitable transport equipment!

Explosion and fire hazard due to explosive gases escaping from the battery. Caution! Metal parts of the battery are always live, therefore do not place items or tools on the battery! Avoid short circuits!

No smoking! Do not expose the battery to an open flame, a glowing fire or sparks as explosion and fire hazards exists.

KNOW YOUR SYSTEM

PREPARATION

Before commencing, some time should be dedicated to working out all the aspects concerned in the system installation.

By following these simple instructions and spending a little time on each, the whole installation process should be easier.

1) Check that all components are present, familiarise yourself with them and make sure that everything has been identified.

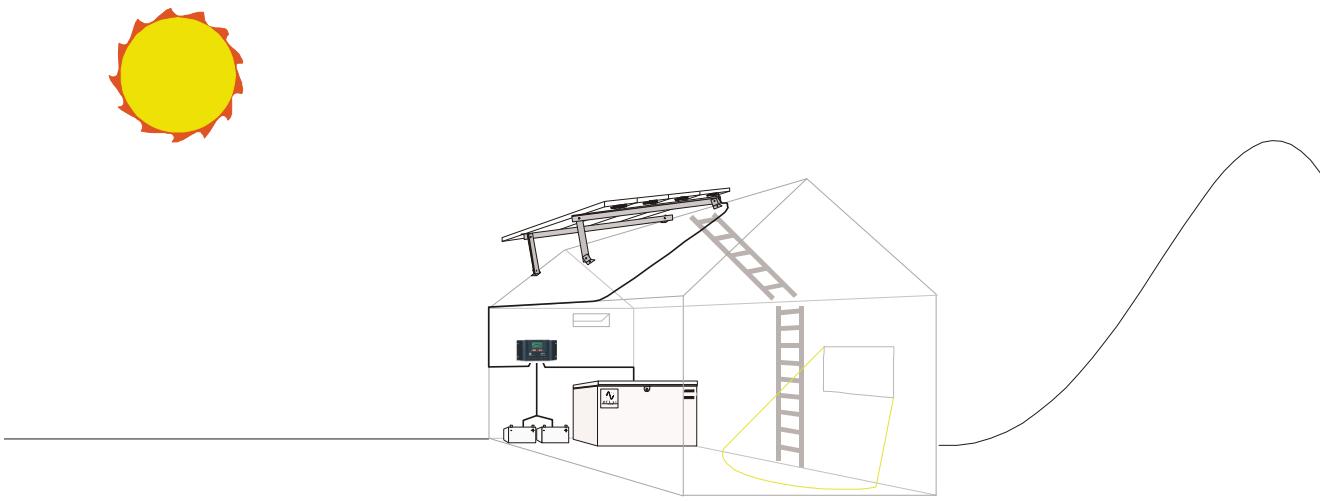
2) Discuss and decide a position for the refrigerator, ensuring that it is well ventilated, dry and not in direct sunlight. The colder the room, the better the performance.

3) Work out a position for the solar array ensuring that it faces the correct direction, is at the correct tilt angle (see page on support structure orientation), no shading will occur, it will not be damaged and it is accessible for cleaning and maintenance.

4) Work out the route for the solar array output cable, ensuring that there is sufficient length to reach the charge regulator.

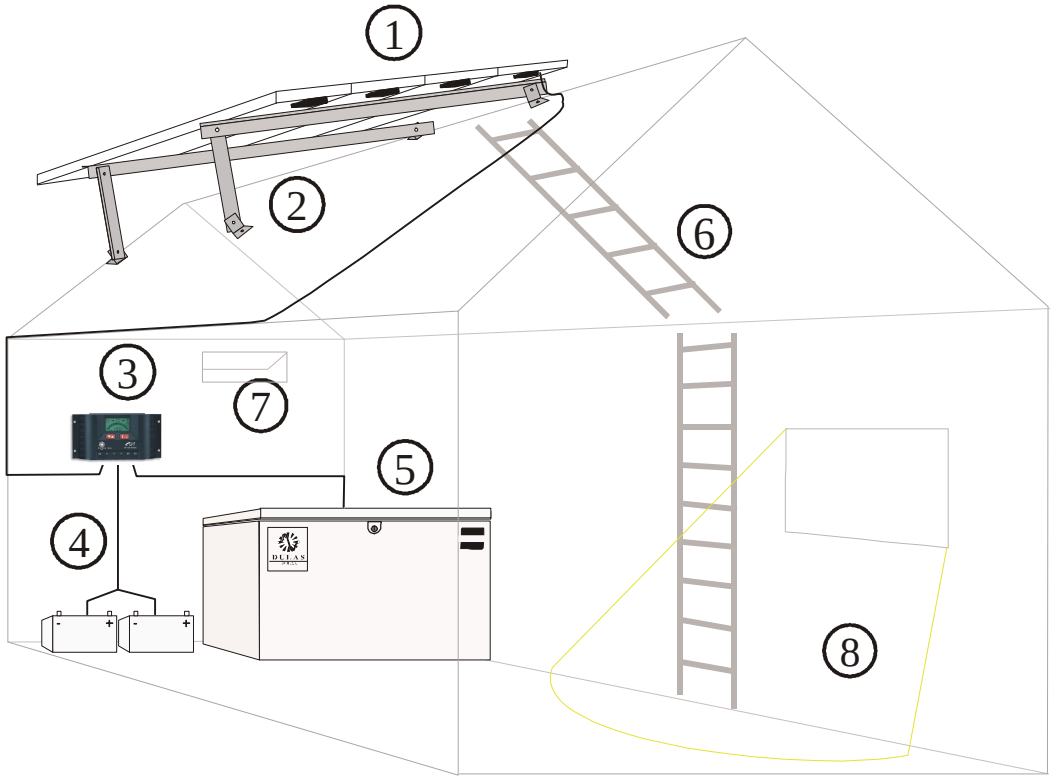
5) Choose a position for the batteries that is well ventilated, dry, safe, not in direct sunlight and accessible for topping up with distilled water. The colder the room the better the performance.

The system, when completely installed should look similar to the drawing below. Each component should have a sensible, well thought out, **safe** location, allowing access for routine maintenance.



KNOW YOUR SYSTEM

COMPLETED



① SOLAR MODULE ARRAY

② SUPPORT STRUCTURE

③ CHARGE REGULATOR

④ BATTERY PACK

⑤ REFRIGERATOR

⑥ SOLAR ARRAY ACCESS

⑦ GOOD VENTILATION

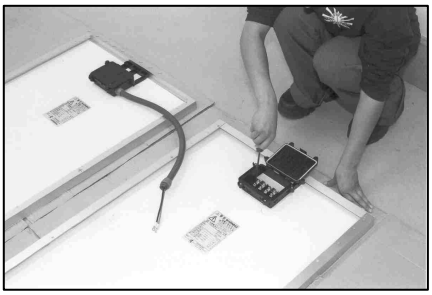
⑧ NO DIRECT SUNLIGHT ON REFRIGERATOR

SOLAR ARRAY

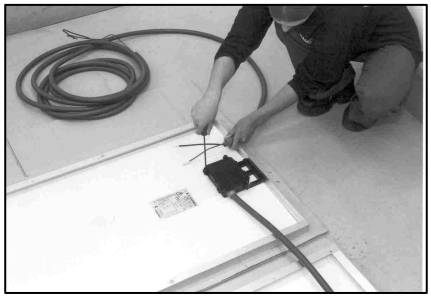
KYOCERA MODULE ASSEMBLY

PLEASE READ ALL OF THE INSTRUCTIONS THOROUGHLY BEFORE COMMENCING
(FOR 12V WIRING LAYOUTS SEE 'JUNCTION BOX WIRING DIAGRAMS')

After ensuring that all the components are present, remove the solar modules (a.1) from their cardboard boxes and lay them next to each other on top of the cardboard, with glass facing down. Do not step on the glass modules. BROKEN MODULES CANNOT BE USED. Arrange the solar modules so that the junction boxes are all on the same side.

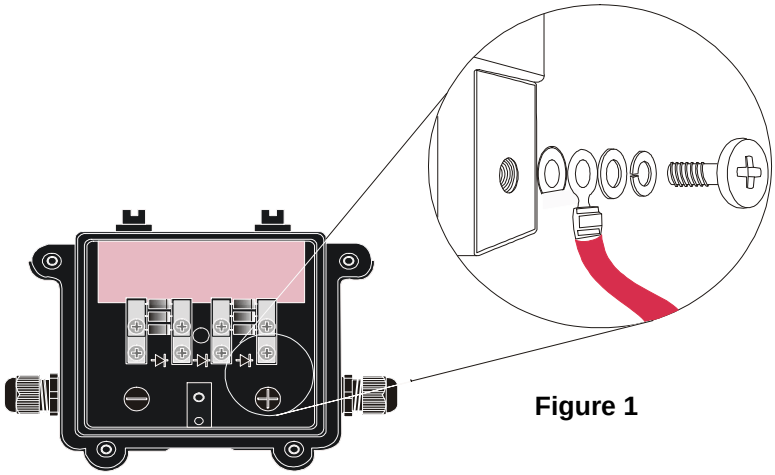


Interconnect the modules with the cables provided (a.3). The interconnect cable has a crimped ring terminal at each end which are easily connected to the Kyocera junction boxes as illustrated below in Figure 1, (remove plastic nut, screw gland in place, replace plastic nut and connect cables.)



The array output cable (a. 2) must then be connected to the nearest module (see System Wiring Diagram), brown or red wire to +, blue or black wire to -. Ensure that there is sufficient cable to meet the necessary distance then insert into the junction boxes as performed previously.

Note : Due to new cable colour regulations brown or red can be used for +ve and blue or black for –ve until 1/4/06 after which time only brown and blue will be permissible.



Lift the cover of the junction box by removing the four screws. Place the ring terminal into position and tighten up the terminal screw until it is gripped securely. Replace the cover of the junction box with the screws provided ensuring a moisture proof seal.

Figure 1

SUPPORT STRUCTURE

ORIENTATION

The solar array must be permanently positioned where the modules will receive the maximum amount of sunshine, however they are very fragile and should not be located where they may be damaged. A suitable position must be found away from trees and tall objects, to avoid shading the array, as this will impair the performance of the modules.

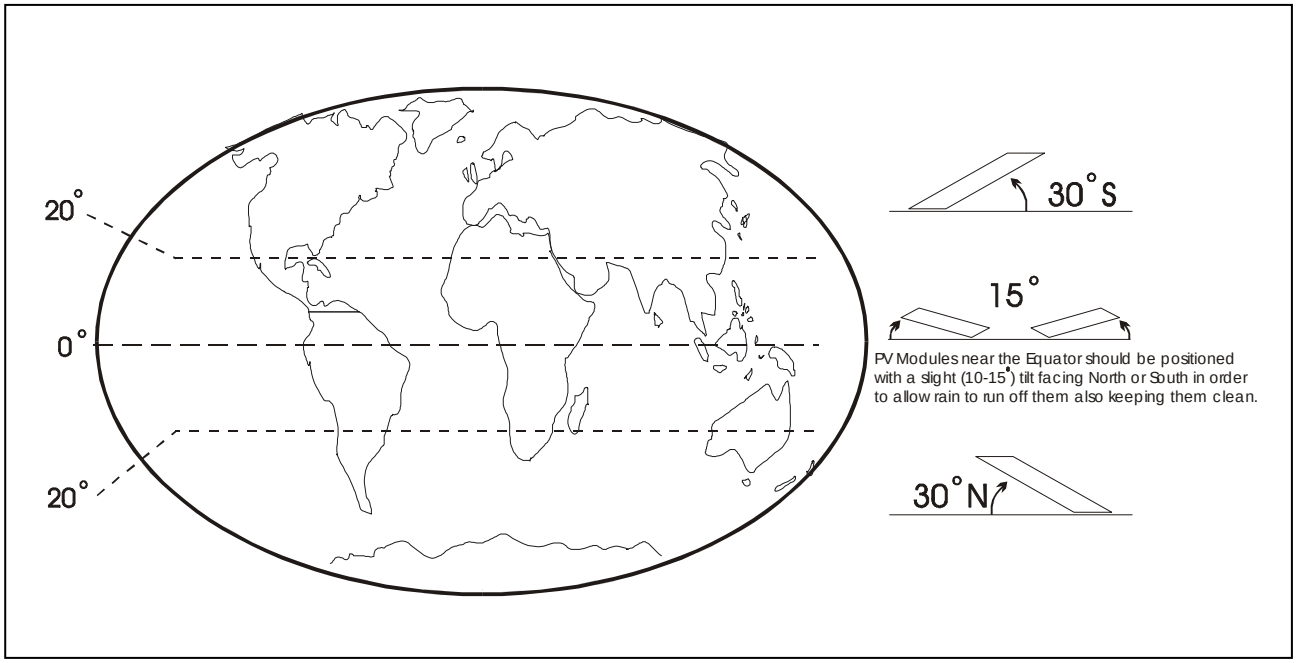
Please ensure that the support structure is:

SECURE AND NOT TWISTED
ACCESSIBLE FOR CLEANING
WELL VENTILATED
SAFE FROM SEVERE WEATHER CONDITIONS
NOT SHADED (BETWEEN 7 am & 5 pm)

The solar array should face towards the equator – i.e. South in the Northern Hemisphere,
North in the Southern Hemisphere.

The tilt angle of a solar array is dependent on the country in which it is located. Figure 2 demonstrates common tilt angles. The front of the solar modules must be cleaned every week or when necessary in dusty areas.

Figure 2

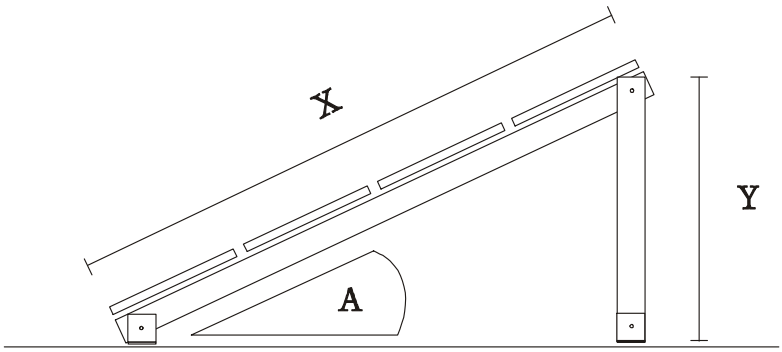

20°
0°
20°
30° S
15°
PV Modules near the Equator should be positioned with a slight (10-15°) tilt facing North or South in order to allow rain to run off them also keeping them clean.
30° N

SUPPORT STRUCTURE

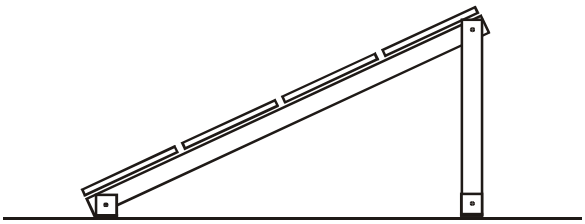
ORIENTATION CONTINUED

The support structure is made from pre-drilled galvanised steel angle. If your mounting area cannot be level e.g. you have a sloping roof, then the correct angle must be made by adjusting the foot mounting holes.

Use the ratios below to calculate your appropriate angle and follow the diagrams to position the structure accurately.

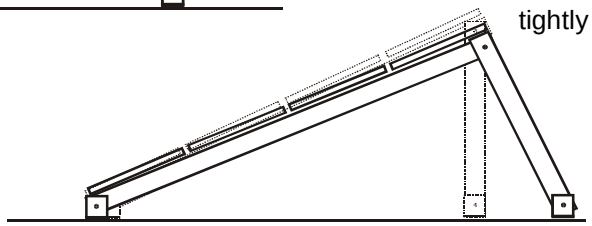


Required Angle (A)	Approx. Ratio (x : y)		Required Angle (A)	Approx. Ratio (x : y)
10°	6 : 1		30°	2 : 1
15°	4 : 1		35°	1.75 : 1
20°	3 : 1		40°	1.5 : 1
25°	2.4 : 1		45°	1.4 : 1

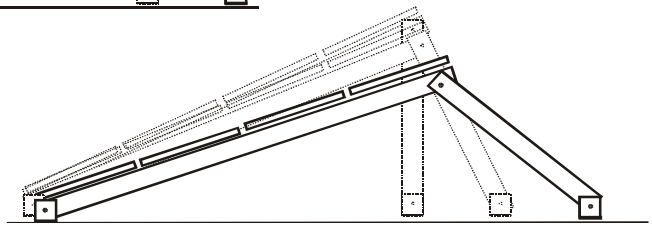


Changing the position or length of the Tilt legs can alter module angles.

Always ensure that all bolts are secured tightly after alterations have been made.



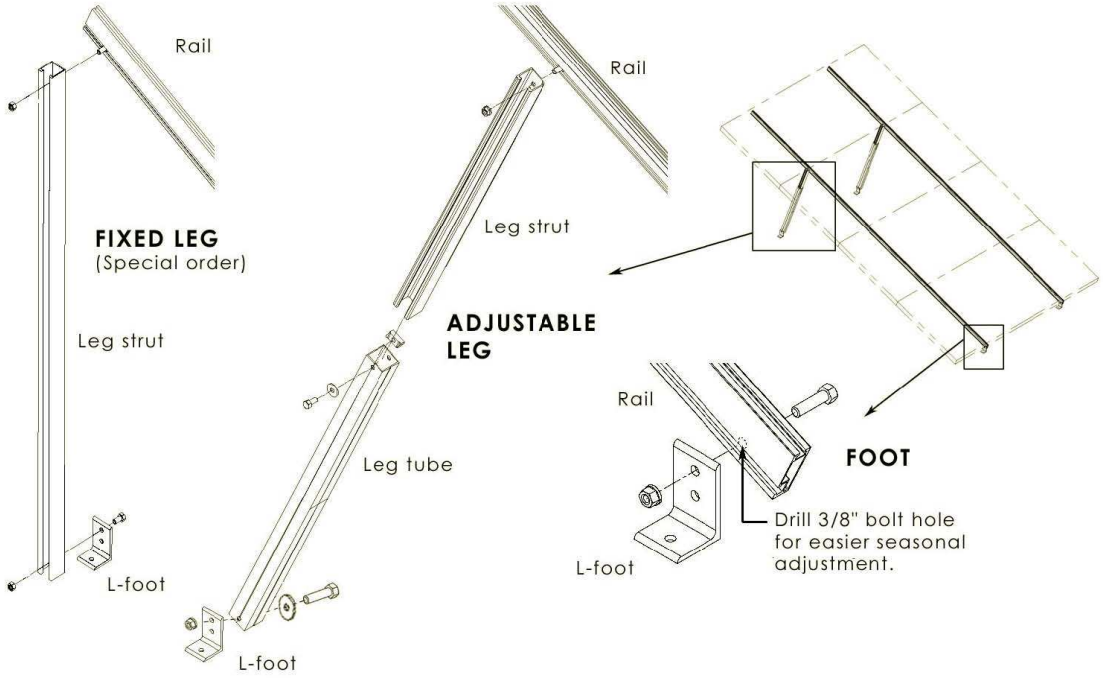
A protractor can be used to determine if the correct angle has been acquired.



SUPPORT STRUCTURE

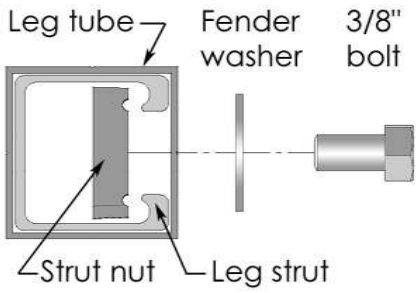
ASSEMBLY

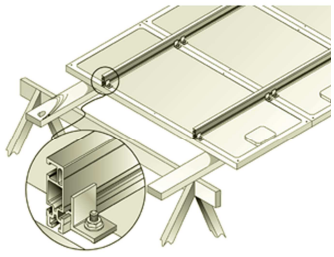
1. Assemble the UniRac TLH High Profile Tilt Legs as shown in the drawing below. The UniRac can easily be assembled in any order appropriate to the job site requirements.



TILT LEG

2. Use 3/8" hardware to assemble the UniRac and ¼" hardware to attach the PV modules to the UniRac.





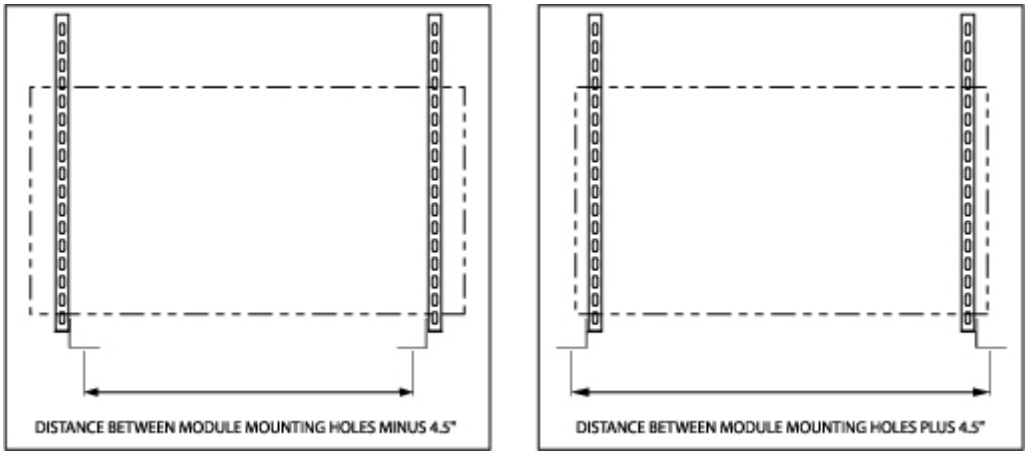
3. UniRacs must be securely attached to roof rafters, ground footings or other secure structural features. Simply screwing the UniRac to roof decking is **not** adequate to withstand high wind loads.

4. Leaving as much space as possible at the bottom of the UniRac will minimize debris accumulation and snow load.

SUPPORT STRUCTURE

LOCATING MOUNTING FEET

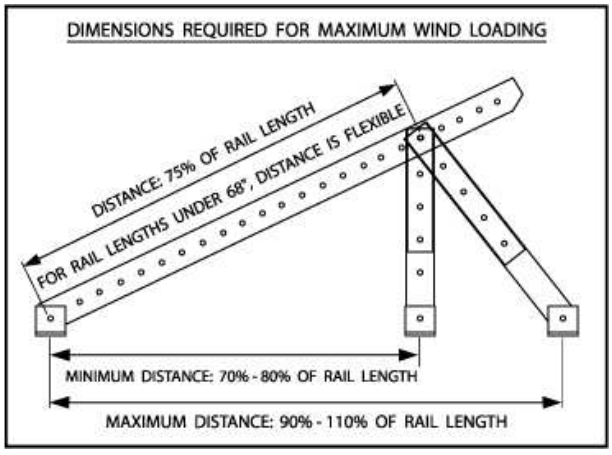
5. The drawing below shows two options for setting the width of the Mounting Feet. If possible, mount a PV module to the UniRails to determine the best attachment method for obtaining the proper distance between the Mounting Feet.



TILT LEG

6. On UniRacs Tilt Leg Kits, rack tilt can be determined by:

A – Raising or lowering the Tilt Leg,
B – Moving the Tilt Leg up or down along the UniRail,
C – Adjusting the distance between the lower and upper Mounting Feet before final installation.


DIMENSIONS REQUIRED FOR MAXIMUM WIND LOADING
DISTANCE: 75% OF RAIL LENGTH
FOR RAIL LENGTHS UNDER 68", DISTANCE IS FLEXIBLE
MINIMUM DISTANCE: 70% - 80% OF RAIL LENGTH
MAXIMUM DISTANCE: 90% - 110% OF RAIL LENGTH

COMPLETED UNIRAC TLH HIGH-PROFILE TILT LEGS INSTALLATION (ADJUSTABLE LEG)

LIGHTNING PROTECTION

MEASURES

LEVEL 1 – NO PROTECTIVE MEASURES – **NOT RECOMMENDED BY DULAS LTD**

Failure to provide protection measures against lightning strike risks damage to the equipment. In the event of lightning striking the roof mounted Solar Array, high voltage may be conducted towards the refrigerator system. This high voltage may damage the electronic components of the system.

LEVEL 2 – LIMITED PROTECTIVE MEASURES (Normally Supplied)

We strongly recommend that at least this level of protection be installed – see figure 1.

Install an earth electrode (earth rod) (A) outside the building – the earth rod should be at least 2m long. Connect the earth rod with good quality wire (at least 6mm²) to the Solar Array and support structure (wire B). The earth wire should follow the shortest and straightest path between the support structure and the earth rod.

LEVEL 3 - FULL LIGHTNING CONDUCTOR SYSTEM (Not Supplied)

Assess the risk of lightning strike. Look at other local buildings – are they fitted with lightning conductors? Ask local people if TV aerials etc often get struck?

If the installation is at high risk of lightning strike then an additional lightning conductor and separate earth rod should be installed – see figure 2.

In addition to level 2 protection, install a second earth electrode (D). The distance between the two earth electrodes must be more than their length. Erect an Air Terminal or Lightning Conductor (D) next to the second earth electrode. The Air Terminal must exceed the height of the Solar Array such that the Solar Array falls within a 45º cone centred on the Air Terminal – this is the area that is protected by the Air Terminal.

Figure 1.

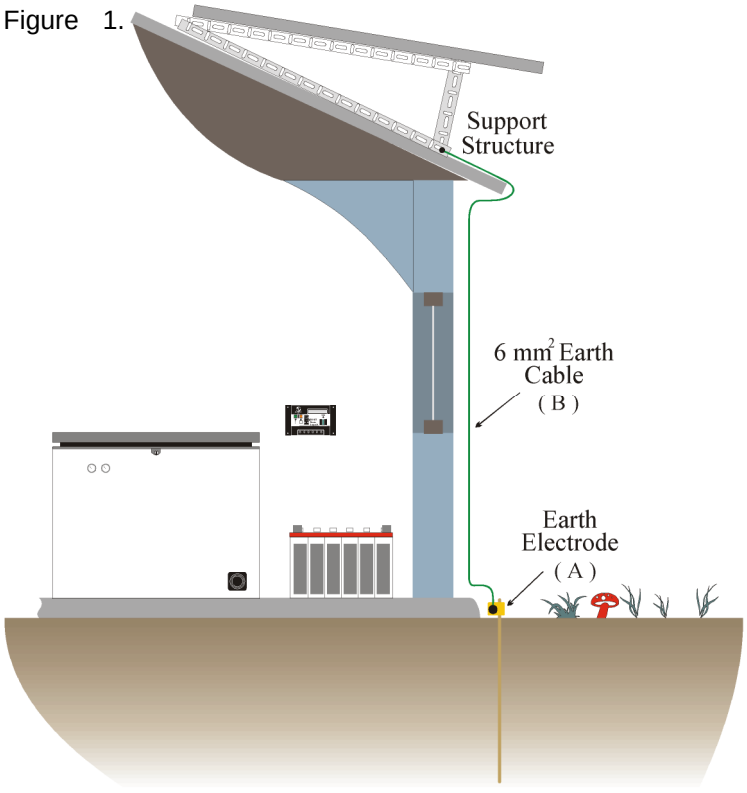
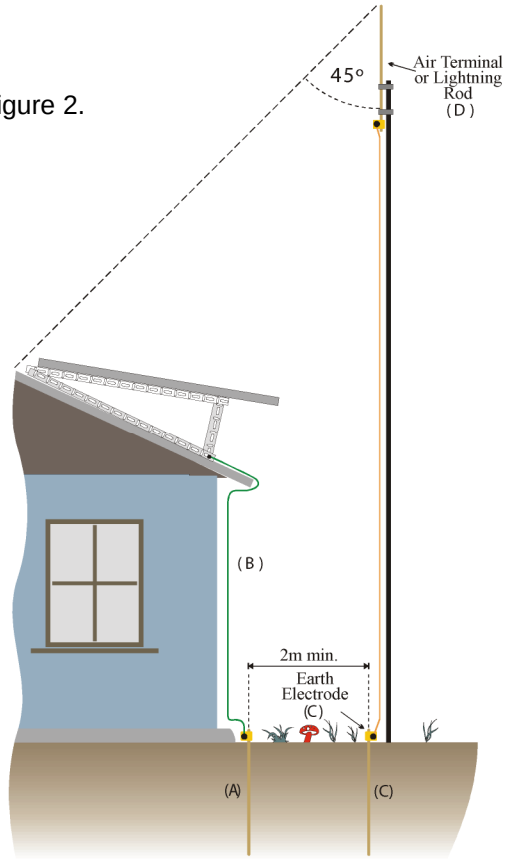


Figure 2.



PHOTOVOLTAIC CONTROLLER

INFORMATION

When using Lead-Acid batteries in photovoltaic systems it is important to protect them against overcharging which would otherwise cause permanent damage. The Charge Controller is installed in the system to perform this task. Over-charge is prevented by limiting the battery voltage to a maximum of around 13.7 Volts at 25℃. The battery can be left charging at this 'float' voltage for long periods. The battery float voltage is temperature compensated. In order to measure the temperature, a temperature sensor is built in to the charge controller. The Controller should therefore be mounted close to the batteries.

Similarly, the battery must be protected against over-discharge. The Controller has an automatic low voltage disconnect facility. In the event of the battery becoming discharged, the refrigerator will be disconnected before permanent battery damage occurs. Re-connection is automatic.

The Photovoltaic Controller is fully automatic in operation. See manufacturer's manual for further information.

Dulas supply one of two different models of Steca Charge controller: either the PR series or the Tarom series. Please compare the charge controller you have to the pictures below to determine which model you have been supplied. The instructions on pages 14 and 15 refer to the PR series and the instructions on pages 16 to 18 refer to the Tarom series.

STECA PR3030 – go to pages 14 and 15

STECA TAROM 235 – go to pages 16, 17 and 18

PHOTOVOLTAIC CONTROLLER – STECA PR SERIES

STECA PR SERIES CHARGE CONTROLLER

OPERATION

The PR series controller is fully automatic in operation. See Steca manual for full information.

CONTROLLER FUNCTIONS

The display window on the front panel shows system information and error messages, the left button on the front panel can be used to switch display windows or calling up settings and the right button is used as a manual load switch, or confirmation button in the programme mode. The three displays, which are the most relevant to the operation of the refrigerator, are as follows:

1. **CORRECT OPERATION**: Indicated by a smiling face in the display window**.** A sad face indicates a fault. The reference number in the display can then be looked up in the manual to give the meaning of the error and the cause/remedy.

2. **STATE OF CHARGE**: Indicated by the bar graph (SOC:) and a percentage on the display. When the state of charge is 50% or less, icepacks should not be frozen.

3. **LOAD DISCONNECTION**: The refrigerator is disconnected when the state of charge drops to 30%. The SOC bar value, or the voltage value, flashes. The face looks sad until the reconnection set point is reached.

THE LCD ALSO PERFORMS VARIOUS OTHER FUNCTIONS. CONSULT THE MANUFACTURER'S HANDBOOK FOR FURTHER INFORMATION.

PHOTOVOLTAIC CONTROLLER – STECA PR SERIES

INSTALLATION

The unit should be installed in a dry location with clear space around it, to allow heat generated at the rear of the unit to be dissipated. The unit is fixed to the wall so that the terminals are at the bottom and the fins running vertically.

INSTALLATION INSTRUCTIONS:

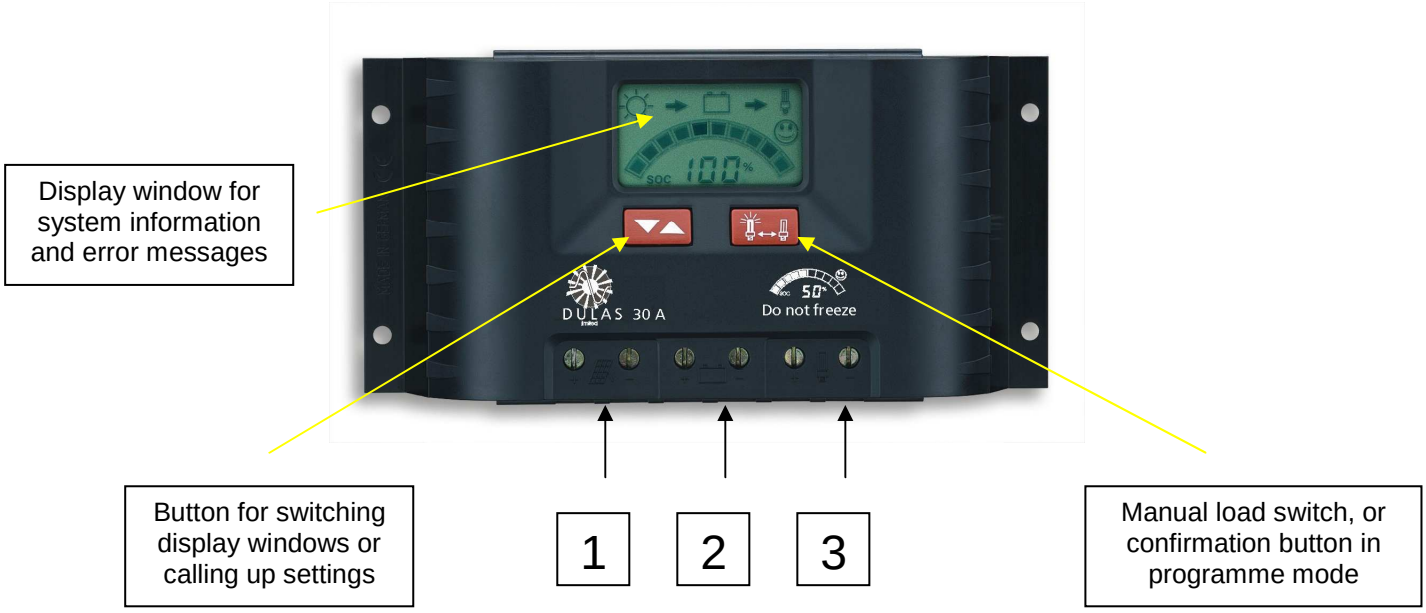
1. Fix the Photovoltaic Controller to the wall with plugs and screws.

2. Connect the battery cable to the central pair of terminals on the unit (2). Taking care to ensure correct polarity (brown or red to +, blue or black to -).

3. The array output cable (a.2) must be connected AFTER the batteries, to the left hand pair of terminals on the unit (1) (brown or red to +, blue or black to -). BE AWARE OF LARGE VOLTAGES. Cover the array or connect at night.

4. The refrigerator is connected to the right hand pair of terminals (3) on the regulator, taking care to ensure correct polarity (brown or red to +,blue or black to -).

5. Support the cables using the clips provided.


Display window for system information and error messages
DULAS 30 A
Do not freeze
Button for switching display windows or calling up settings
1
2
3
Manual load switch, or confirmation button in programme mode

PHOTOVOLTAIC CONTROLLER – STECA TAROM SERIES

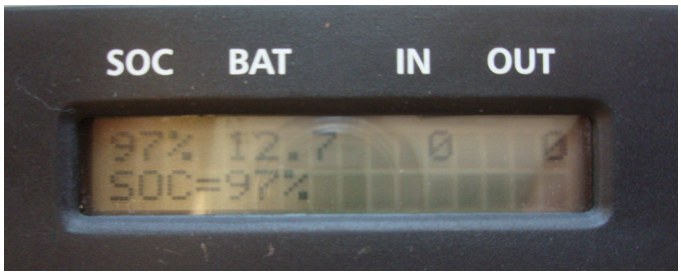
STECA TAROM SERIES CHARGE CONTROLLER

OPERATION

The Photovoltaic Controller is fully automatic in operation. See manufacturer's manual for information.

CONTROLLER FUNCTIONS

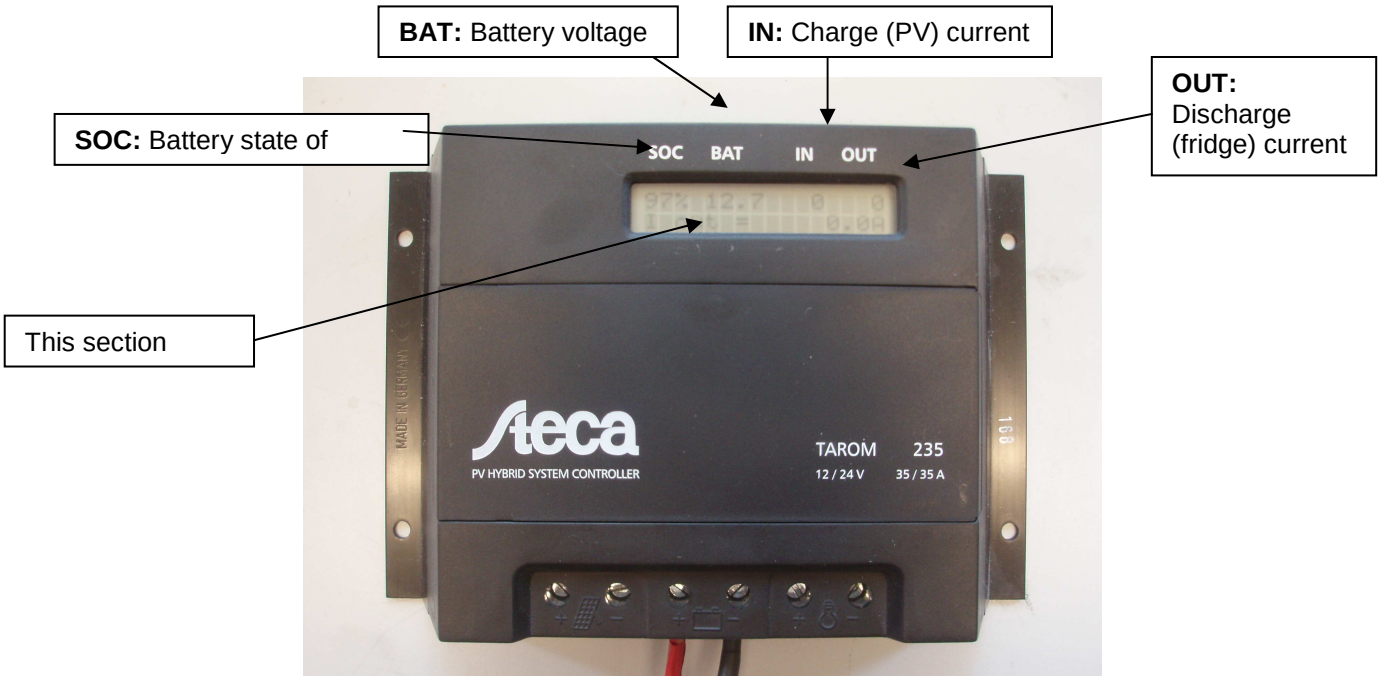
1. **STATE OF CHARGE**: Indicated by a percentage at the top left of the display. When the state of charge is 50% or less, icepacks should **not** be frozen.



2. **LOAD DISCONNECTION**: The refrigerator is disconnected when the state of charge drops below 30%.

PHOTOVOLTAIC CONTROLLER – STECA TAROM SERIES

3. DISPLAY FUNCTIONS (for 35a and 45a)



The rotating display goes through the following screens:

SOC = xx %	State of charge of the battery
U BAT = xx V	Voltage of the battery
I accu = + xx A	Battery current (charging is +ve)
I out = xx A	Fridge current
I in = xx A	Charge current
I mod = xx A	Current available from PV
manual auto	System is in automatic mode
normal charge	Indicates ‘normal’ or ‘boost’ charge
fixed electrolyte	Controller is pre-set for sealed gel battery

4. The display also indicates various system faults and other functions. Consult the manufacturer’s manual for further information.

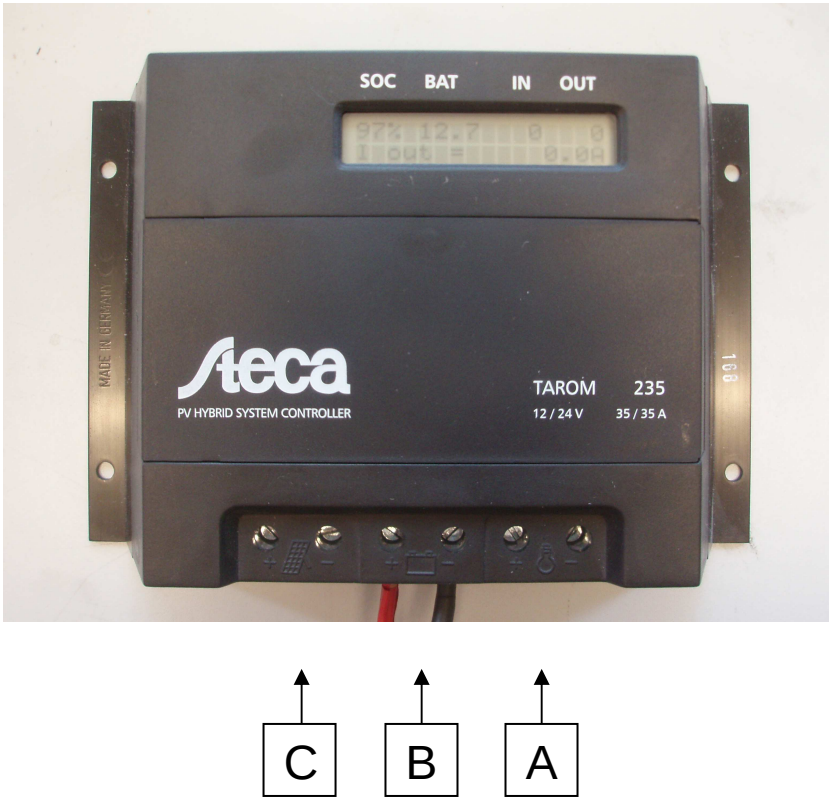
PHOTOVOLTAIC CONTROLLER – STECA TAROM SERIES

INSTALLATION

The unit should be installed in a dry location with clear space around it, to allow heat generated at the rear of the unit to be dissipated. The unit is fixed to the wall so that the terminals are at the bottom and the fins running vertically.

Installation Instructions

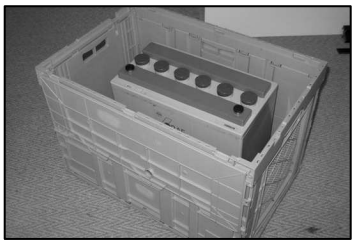
1. Fix the Photovoltaic Controller to the wall with plugs and screws.
2. Connect the refrigerator to the right hand pair of terminals (A) on the controller, taking care to ensure correct polarity (brown or red to +,blue or black to -).
3. Connect the battery cable to the central pair of terminals on the unit (B), taking care to ensure correct polarity (brown or red to +, blue or black to -).
4. Install the battery fuse.
5. Check the controller display is working, then connect the array output cable to the left hand pair of terminals on the controller (C), (brown or red to +, blue or black to -).
6. Support the cables using the clips provided.



COMMISSION THE BATTERIES

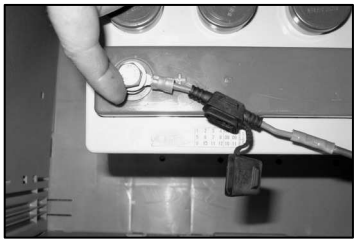
CONNECT THE BATTERIES

THE BATTERY BOX MUST ALWAYS BE LOCATED IN A VERY WELL VENTILATED AREA AS THE BATTERIES GENERATE HYDROGEN, WHICH IS AN EXPLOSIVE GAS.

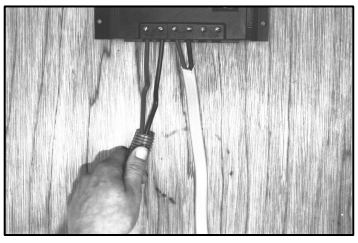


1. After choosing a final location, carefully place the batteries into the empty box, ensuring not to lift by the terminal points. THE BATTERIES ARE NOW EXTREMELY HEAVY.

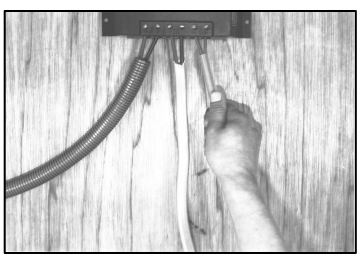
2. Connect the battery-to-regulator cable to the regulator FIRST, brown or red to + and blue or black to – THEN to the battery. Secure in place using the nuts, bolts and washers provided. Insert a spare fuse (d.7) into the fuse holder on the battery-to-regulator cable. Any problems refer to the manufacturers handbook provided.



3. Apply petroleum jelly or similar to each battery terminal – this helps avoid corrosion.



4. Commence charging of the batteries immediately by connecting the solar array cable to the PV Controller. **DO NOT CONNECT THE REFRIGERATOR** as the batteries need an initial charging of two good sunny days for optimum performance.



5. Once the batteries are ready for operation (after two good sunny days of charging), the refrigerator can be connected.

THE REFRIGERATOR / FREEZER

POSITIONING

DO NOT POSITION THE VC150 REFRIGERATOR / FREEZER IN DIRECT SUNLIGHT

ENSURE THAT THE REFRIGERATOR IS WELL VENTILATED, ESPECIALLY THE VENTILATION GRILLES AND CONDENSER.

WE RECOMMEND LEAVING A 500mm GAP AT EACH END OF THE REFRIGERATOR

NEVER OBSTRUCT THE TEMPERATURE OR REGULATOR DISPLAYS

ENSURE THAT THE BATTERY BOX AND BATTERIES CAN BE INSPECTED WHEN NECESSARY

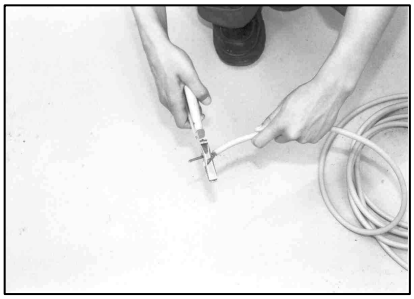
NEVER BLOCK THE CIRCULAR COMPRESSOR VENTILATION FAN AT THE FRONT

STARTING THE FRIDGE

The VC150 Refrigerator is designed for continuous operation, therefore an ON/OFF switch is not provided, as it is not necessary. The VC150 Freezer however, **does** have an ON/OFF switch to allow for defrosting. This is situated at the rear right of the cabinet, as viewed from the front, above the cable gland (see General Layout Diagram).

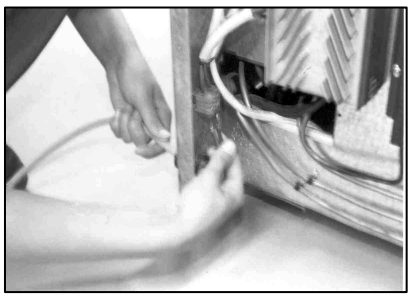
The VC150 Refrigerator/Freezer is operational when the power cable is connected to the controller.

a) Strip the power cable to reveal 10 mm of brown or red (+) and blue or black (-) wire.



b) Insert the cable into the black strain relief gland, located at the rear, see 'Cable Entry' in the General Layout Diagram.

c) Connect to + & - terminals on opposite side of the strain relief gland.



d) TIGHTEN THE TERMINALS SECURELY,
TIGHTEN THE STRAIN RELIEF GLAND SECURELY.

THE REFRIGERATOR / FREEZER

LOADING

IN ORDER TO KEEP INTERNAL TEMPERATURES OPTIMUM AND MINIMISE ENERGY CONSUMPTION, ONLY OPEN THE LID WHEN STRICTLY NECESSARY AND ALWAYS REPLACE INNER FOAM LIDS

The VC150 Refrigerator / Freezer has two compartments, see General Layout Diagram:

1) The smaller Freezer (ice pack) compartment to the left.

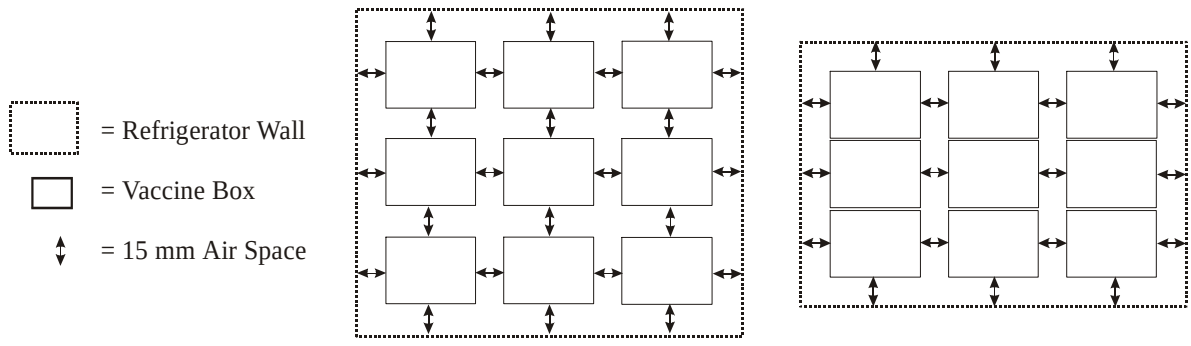
2) The larger Refrigerator (vaccine) compartment to the right.

ICE PACKS: When frozen ice packs are needed; switch the freezer ON, insert ice packs with basket into the LEFT compartment. Ice packs must be in contact with the freezer compartment walls for efficient freezing. A wire basket is provided to hold the ice packs against the walls of the compartment. Only three sides of the compartment can be used for freezing ice packs as the fourth has the thermostat sensor mounted on it. The sensor is protected by a small wire cage. Ice packs are removed by simply reaching inside the basket, and sliding the ice packs up and out of the ice freezing area. Frozen ice packs can be stored in the space inside the wire basket. The freezer can freeze nine ice packs simultaneously. Remember to switch the freezer OFF when not in use – to save energy.

WARNING: STANDARD SYSTEMS ARE DESIGNED TO ONLY FREEZE 2.4 KG's OF ICE PER 24 HOURS, FREEZING MORE WILL FLATTEN THE BATTERIES.

VACCINES: The refrigerator compartment situated to the RIGHT is in constant operation. The wire baskets in the refrigerator compartment are designed to prevent the contents of the compartment from touching the cold sides, and to encourage the circulation of air. Good air circulation will help the refrigerator to maintain an even temperature throughout the compartment. The contents of the compartment should be arranged to allow good air circulation. In order to save energy, try to keep the lid open for as short a time as possible. Try to allocate a certain space for each different type of vaccine, so that they may be located rapidly. Check the vaccine labels and adhere to any special requirements, always use before expiry date (store older vaccines on top).

WARNING : ALWAYS FOLLOW THESE VACCINE STORAGE GUIDELINES



TOP VIEW SIDE VIEW

FRIDGE TEMPERATURE CONTROLLER

Does the controller on your fridge/freezer look like this?

If so go to page 23

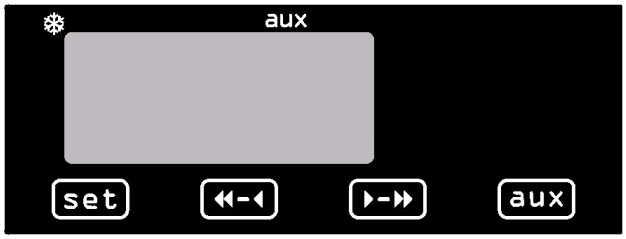
Does the controller on your fridge/freezer look like this?

If so go to page 24

FRIDGE TEMPERATURE CONTROLLER

INSTRUCTIONS

The temperature controller has four buttons: SET, <<-<, >->> and AUX.



TO BE DONE ONCE ONLY

The electronic controller is adapted to control the appliance by setting parameters that have been developed by our engineers to ensure the correct internal operating temperatures.

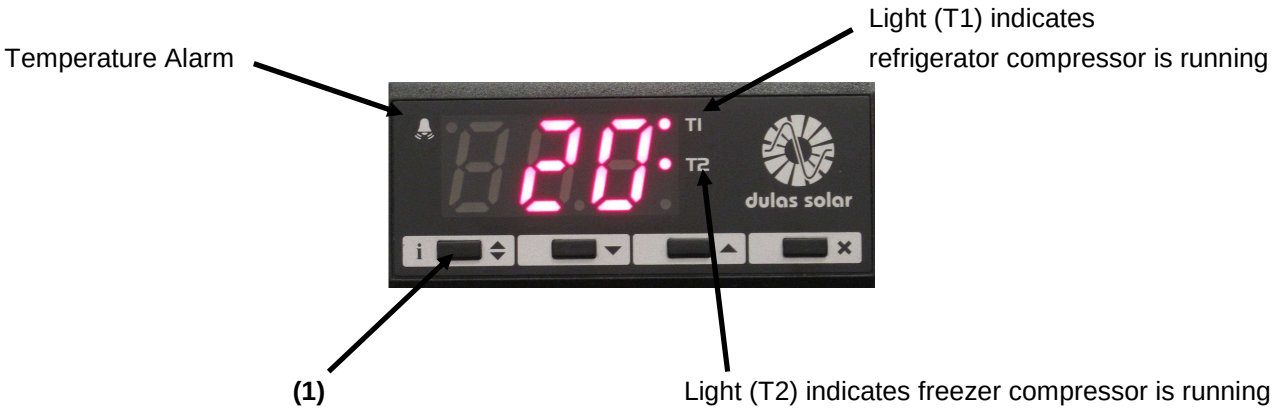
The setup is accessed by pressing the buttons ◂ + SET + ▸ in succession and keeping them pressed simultaneously for 3 seconds. The available parameters are shown in the table below. Press the button ▸ to pass from one parameter to the next and the button ◂ to go back. Press SET to display the value correlated to the parameter and press SET and ▸ or ◂ simultaneously to change it. Exit from setup is by pressing AUX or is automatic after 30 seconds of not using the keypad. Set point SP display and adjustment is also possible during normal operation of the controller by pressing the SET and ◂ or ▸ buttons. The range in any case remains within the limits SPL and SPH.

SETTINGS

The controller has a number of variables as shown in the table below.

Parameter	Description	Fridge	Freezer
SCL	Readout scale	2	2
SPL	Minimum temperature set point	4	-7
SPH	Maximum temperature set point	4	-7
SP	Effective temperature set point	4	-7
HYS	Thermostat hysteresis	3	4
CRT	Compressor rest time	3	3
CDC	Compressor regulation with sensor T1 failure	5	5
DFR	Defrosting frequency /24h	1	1
DTO	Defrosting duration	1	1
DDY	Defrosting display control	1	1
ATL	Low alarm differential	-3	-8
ATH	High alarm differential	2	3
ATD	Temperature alarm delay	15	15
ACC	Condenser periodic cleaning	0	0
OS1	Sensor T1 correction	0	0
SIM	Display slowdown	20	20

FRIDGE TEMPERATURE CONTROLLER



The controller normally displays vaccine temperature. To see freezer temperature follow these steps:

Press button **(1)** - the controller displays ‘hi’

Hold button **(1)** - the controller displays max temperature (eg 08)

Release button **(1)** - the controller displays ‘Lo’

Hold button **(1)** - the controller displays the minimum temperature (eg 03)

Release button **(1)** - the controller displays ‘t1’

Hold button **(1)** - the controller displays vaccine temperature (eg 06)

Release button **(1)** - the controller displays ‘t2’

Hold button **(1)** - the controller displays freezer temperature (eg -6)

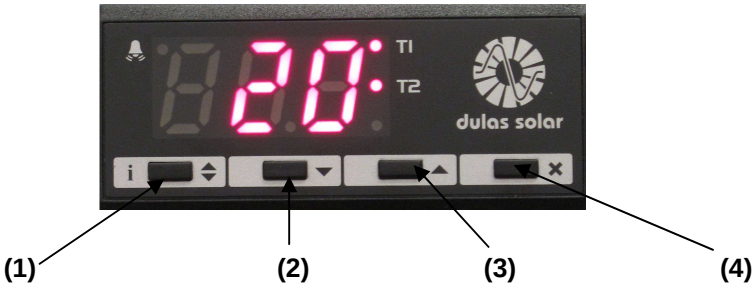
Do nothing for 10 seconds and the display reverts to vaccine temperature.

The temperature alarm has a sound warning (beep). To cancel press button **(1)**

Note: see appendix A for temperature controller settings.

APPENDIX A: TECHNICIAN'S INSTRUCTIONS

The temperature controller settings have been developed by our engineers to ensure that the vaccine and freezer temperatures are correct for a wide range of ambient temperature environments. Adjusting these settings may result in the refrigerator not working correctly and may result in damaged vaccine.



To adjust the vaccine storage temperature setpoint, adjust parameters SPL, SPH and SP1. These should all be the same value. To adjust the freezer temperature, adjust parameter SP2 only.

CONFIGURATION

- The setup menu is accessed by pressing button **(4)** + **(1)** until display changes (approx 6 secs).
- With button **(2)** or **(3)** select the parameter to be modified.
- Press and hold button **(1)** to display the value, when button **(1)** is released the next parameter is displayed.
- By keeping button **(1)** pressed, use button **(2)** or **(3)** to set the desired value.
- When button **(1)** is released, the newly programmed value is stored and the next parameter is displayed.
- To exit from the setup, press button **(4)** or wait for 30 seconds.

CONFIGURATION PARAMETERS

Parameter	Description	Factory setting	Units
SCL	Readout scale	2℃	
SPL	Minimum fridge setpoint	03	℃
SPH	Maximum fridge setpoint	03	℃
SP1	Fridge Setpoint	03	℃
HY1	OFF/ON fridge differential	03	℃
SP2	Freezer Setpoint	-07	℃
HY2	OFF/ON freezer differential	04	℃
CRT	Compressor rest time	3	minutes
CT1	Compressor run with probe faulty	3	minutes
CT2	Compressor stop with probe faulty	6	minutes
CSD	Compressor stop delay after door open	0	minutes
DFR	Defrost frequency expressed in cycles/24 hours	0	
DTO	Maximum defrost duration	20	minutes
DDY	Display during defrost	10	minutes
ATM	Alarm Threshold management (fridge)	ABS	
ALA	Low temperature alarm threshold (fridge)	01	℃
AHA	High temperature alarm threshold (fridge)	10	℃
ATD	Delay before alarm temperature warning (fridge)	15	minutes
ADO	Delay before door open alarm warning	0	minutes
SB	Stand-by button enabling	NO	Flag
DS	Door switch input enabling	NO	Flag
INP	Temperature sensor selection	SN4	
OS1	Fridge probe offset	-02	℃
T2	Second Probe	YES	Flag
OS2	Freezer probe offset	-02	℃
TLD	Delay for min and max temperature logging	5	minutes
SIM	Display slowdown	20	
ADR	Address for PC communication	01	

ROUTINE MAINTENANCE

CHECK TEMPERATURES

The temperature inside the refrigerator should be checked each morning and afternoon. The temperature must be between 2℃ and +8℃. If the temperature i s not within this range then something is wrong and the vaccines will be unusable. Consult the W.H.O. Fault Finding and Repair of Photovoltaic Refrigerators (provided with each refrigerator).

Check the temperature by placing a thermometer next to the temperature sensor (situated at the rear of the right hand compartment) and closing the lid. After five minutes, remove the thermometer, read and record the temperature on a relevant data sheet.

CHECK LIGHTS

Check that the warning lights on the Photovoltaic Charge Regulator are not lit, and that operation is normal. If there is a problem then record this and refer to the W.H.O Fault Finding and Repair of Photovoltaic Refrigerators (attached).

DEFROSTING

If there is a build up of ice (5 mm or more) on the walls of the freezer, then it must be removed by defrosting. The refrigerator can be kept running, or cleaned at the same time.

WARNING: NEVER REMOVE ICE WITH KNIVES OR SHARP OBJECTS OR USE SCOURING POWDER, ABRASIVE CLEANERS OR STEEL WOOL AS THIS WILL DAMAGE THE METAL PLATING AND CAUSE CORROSION.

1.) If the refrigerator is to be cleaned, move the vaccines into another fridge or a cold box, which can ensure the correct temperature is sustained throughout the defrosting process.
2.) Switch the freezer OFF (see General Layout Diagram).
3.) Open the outer lid, remove the appropriate inner lids, leaving the freezer for at least 30 minutes to warm up.
4.) When possible, remove ice with fingers or wooden / plastic tools.
5.) Hand-warm water can be used to assist the defrosting process.
6.) Dry the ice compartment after the ice has melted and clean the vaccine compartment with soapy water, then dry it carefully.
7.) Clean the outer lid seal (talcum powder can be sprinkled on it to prevent it from sticking).
8.) Switch the freezer back ON and close the lid.
9.) After 2 hours check the temperature. Wait until the inside temperature has fallen to between 2℃ and +8℃ and the compressor has stopped running continu ously.
10.) Return the vaccines to the refrigerator and close the lids.

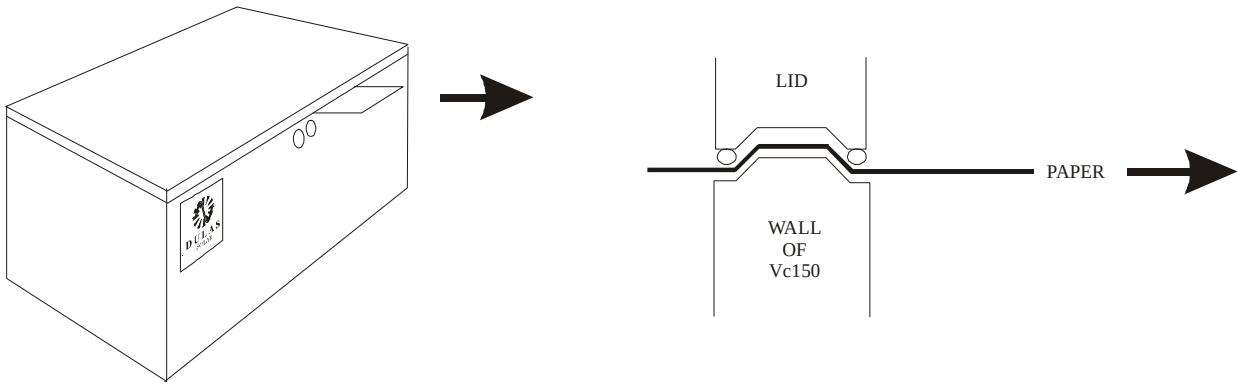
DEFROSTING MUST BE COMPLETED AS QUICKLY AS POSSIBLE, TO PREVENT DAMAGE TO THE VACCINES

ROUTINE MAINTENANCE

CHECKING THE LID SEAL

The lid seal is the most likely area of heat penetration. If the lid hinges are wrongly aligned or the lid seal damaged, the system will have to work harder to maintain the vaccine temperature. When the batteries run out of energy the system will fail, therefore the lid seal must be checked regularly.

The easiest way to check your seal is to position a piece of paper between the lid and the wall, then after closing the lid, try to remove the paper.



Check the seal in this way around the entire lid, **especially the corners**. If the paper moves easily, then the lid seal needs attention, it may need to be re-glued or completely replaced, alternatively the refrigerator hinges may need adjusting so that the lid is sitting correctly.

CHECK FOR SHADOWS

Any shading of the array (solar panels) will reduce it's output, therefore the array must be checked three times in one day, at 7 am, 12 midday and 5 pm, to ensure all possible shade sources are eliminated.

Cut back any bushes or trees which cause shading, seeking permission and explaining why firstly.

Move anything that has been placed in front of the array, and may block the sunshine falling on it.

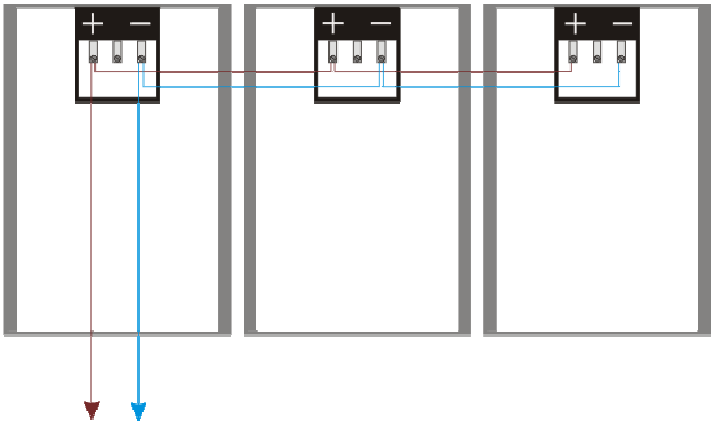
If there have been any new buildings or structures erected which cause shadowing, then the array must be moved to an unshaded area.

CHECK ALL CONNECTIONS

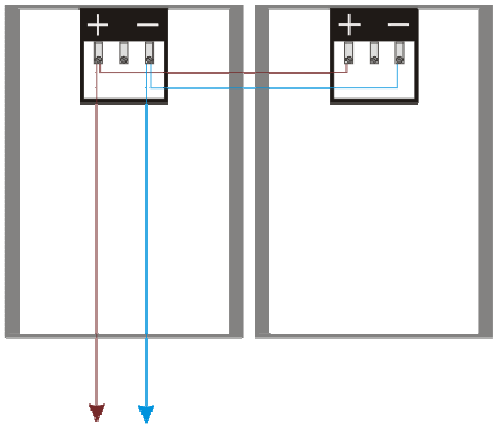
Check each electrical connection thoroughly, making sure every nut and bolt, are secured tightly.

MODULE AND BATTERY WIRING DIAGRAMS

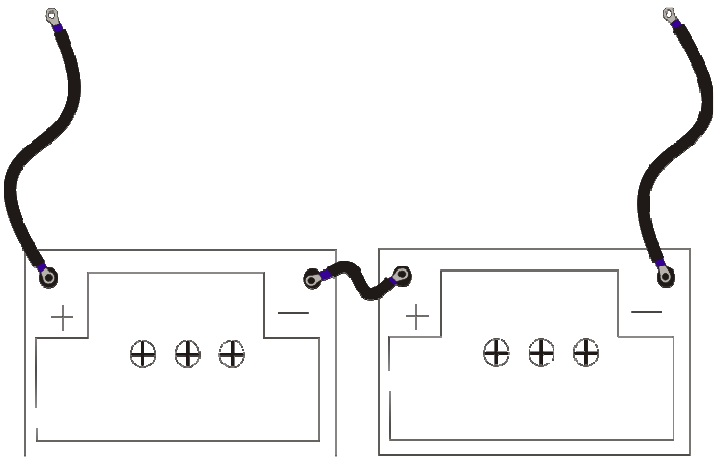
3 x KD135 - 12 VOLT MODULES



2 x KD135 - 12 VOLT MODULE LAYOUT

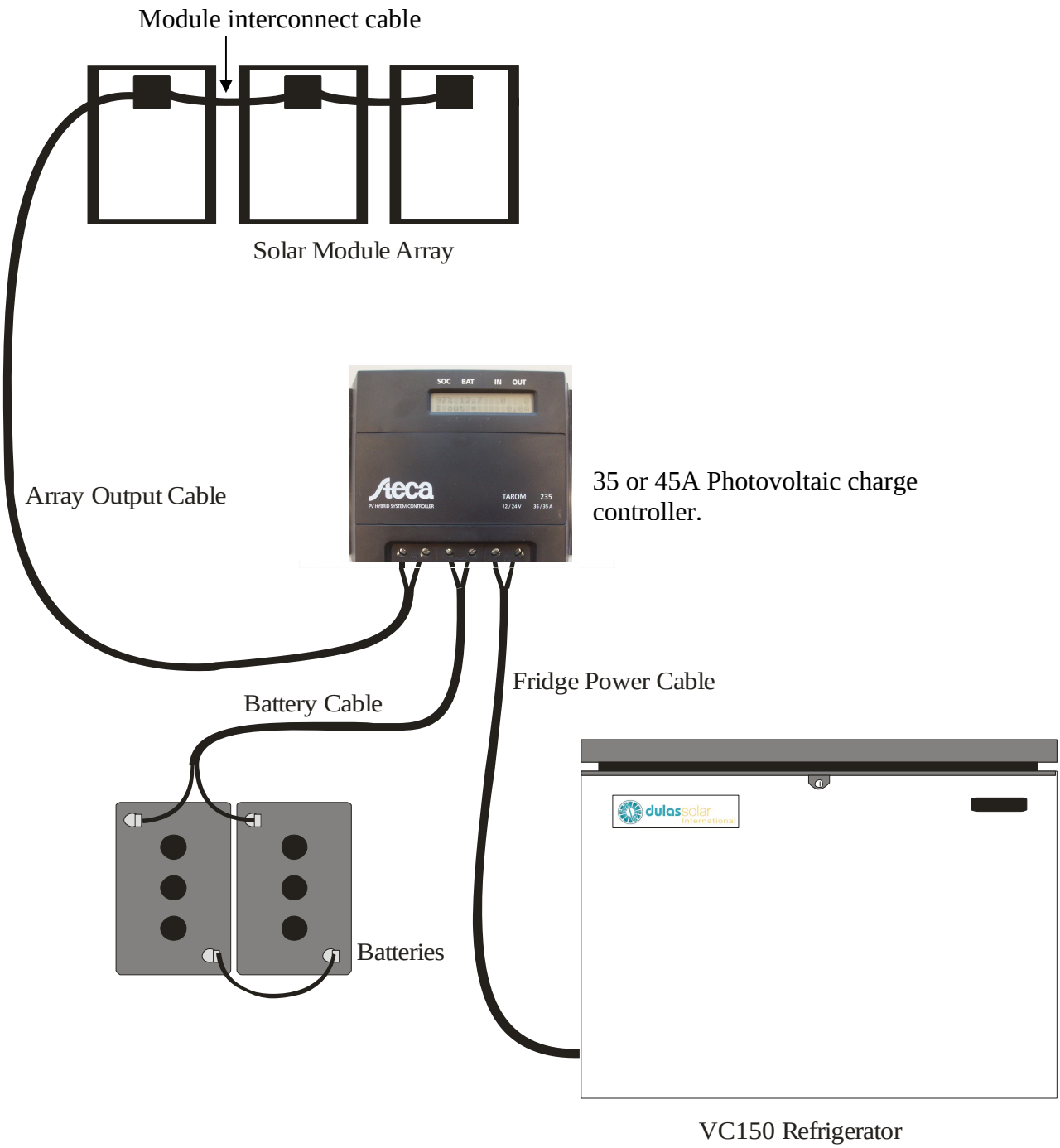


2 x 6 VOLT BATTERIES



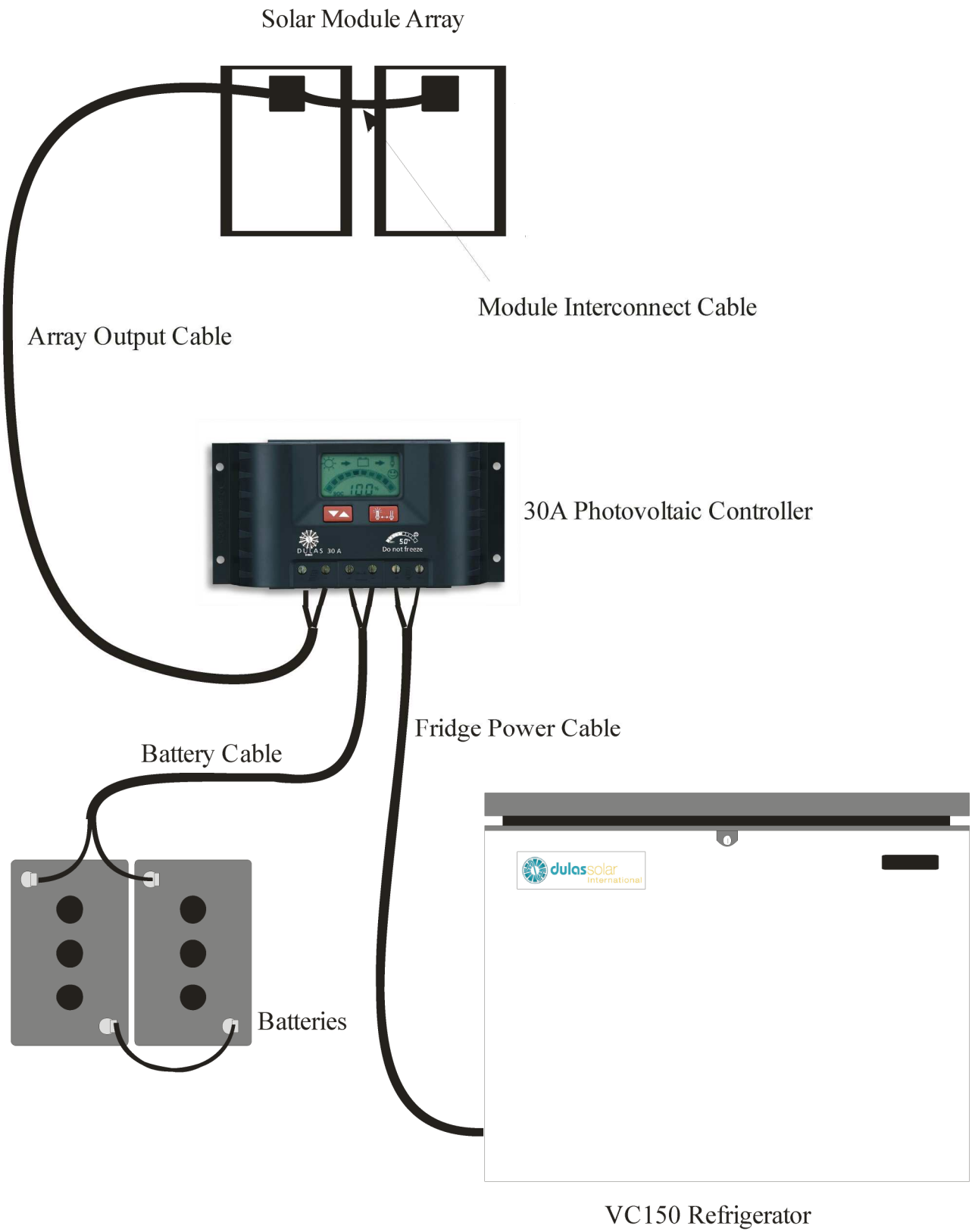
SYSTEM WIRING DIAGRAM (Version 1)

VC150 REFRIGERATOR / FREEZER



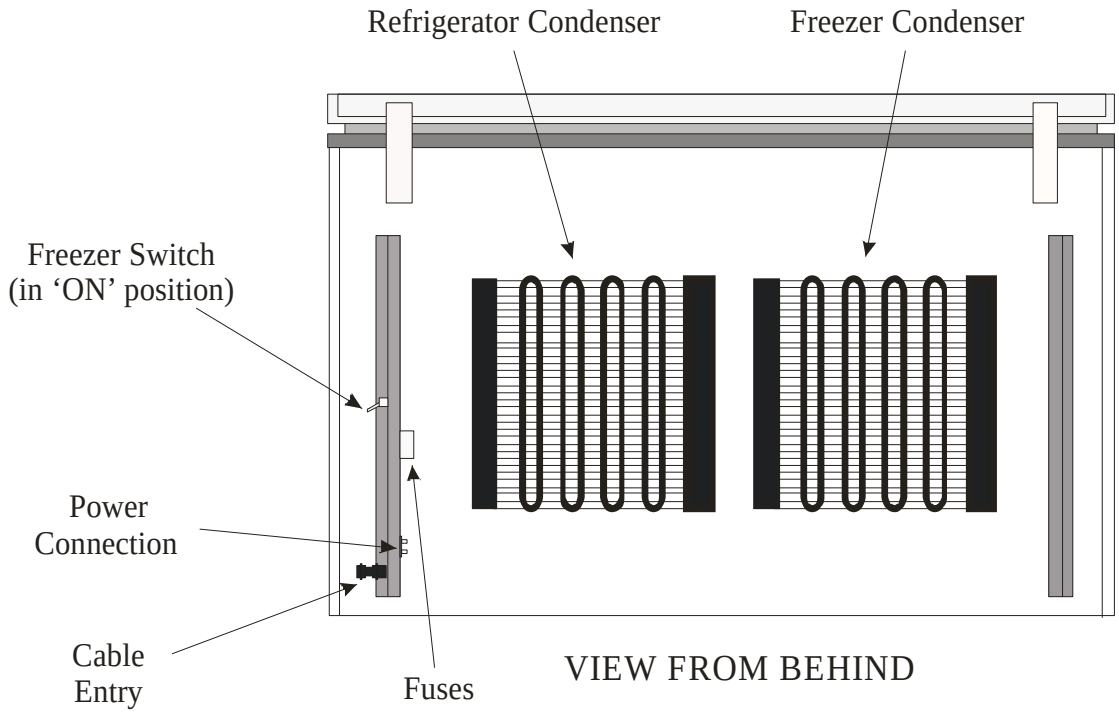
SYSTEM WIRING DIAGRAM (Version 2)

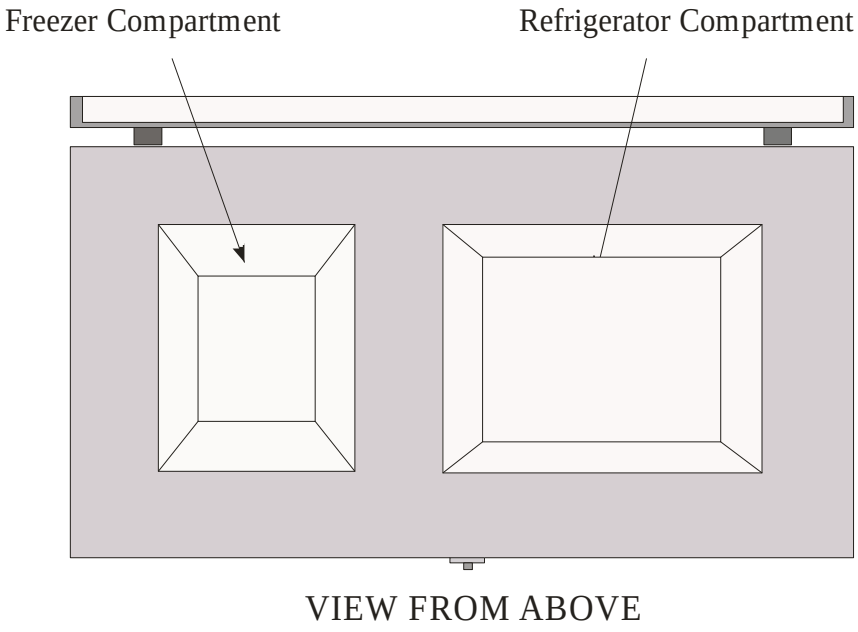
VC150 REFRIGERATOR / FREEZER



GENERAL LAYOUT DIAGRAM

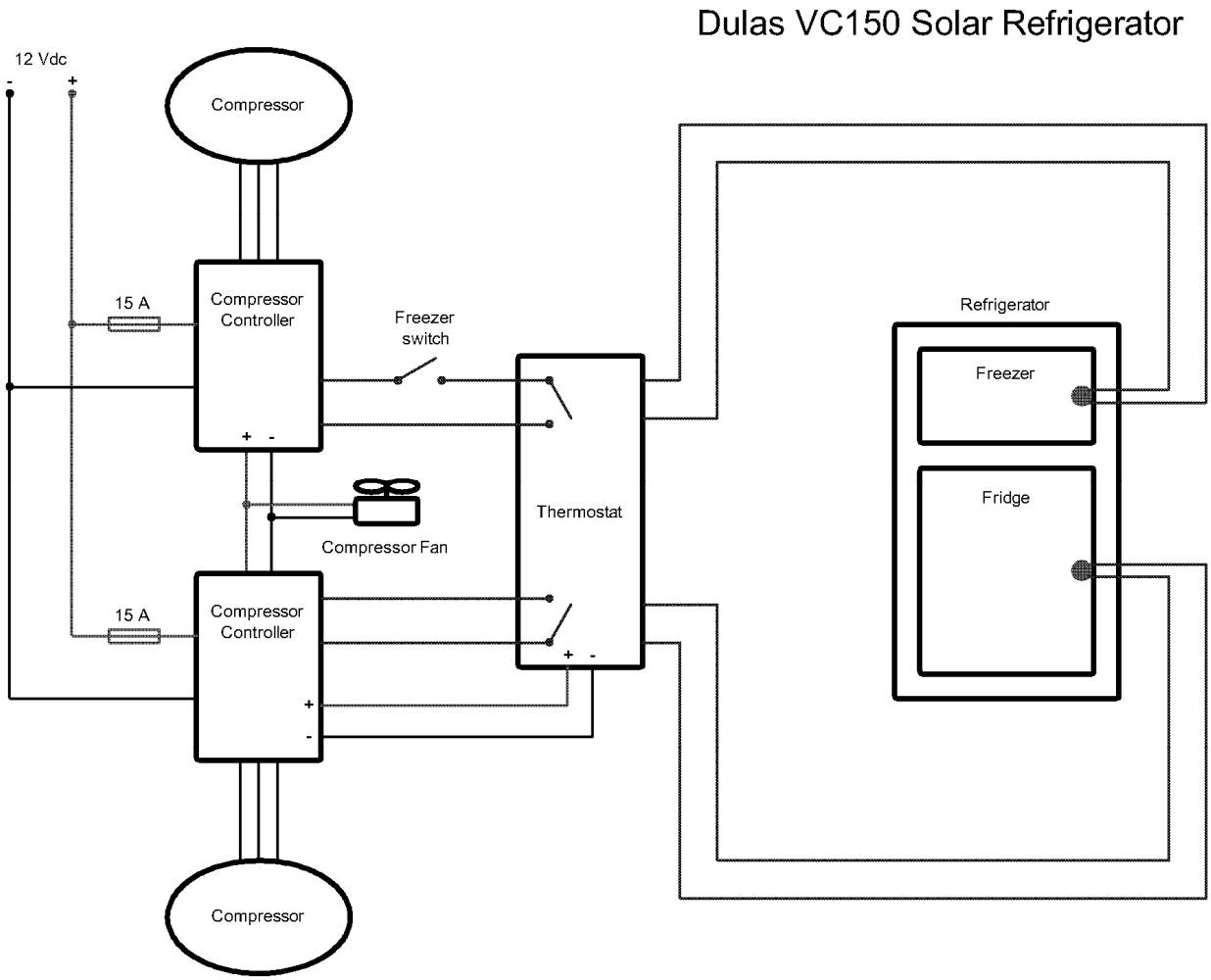
VC150 REFRIGERATOR / FREEZER





ELECTRICAL SCHEMATIC

VC150 REFRIGERATOR / FREEZER

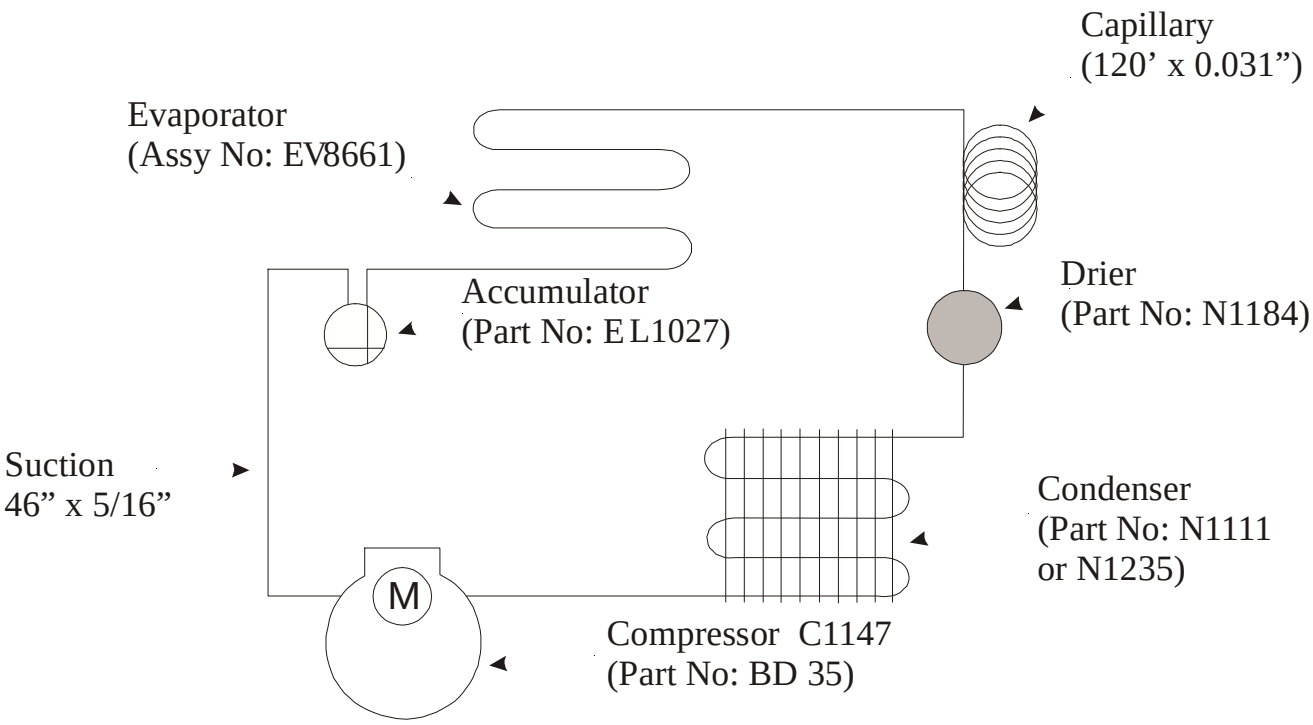


Parts List

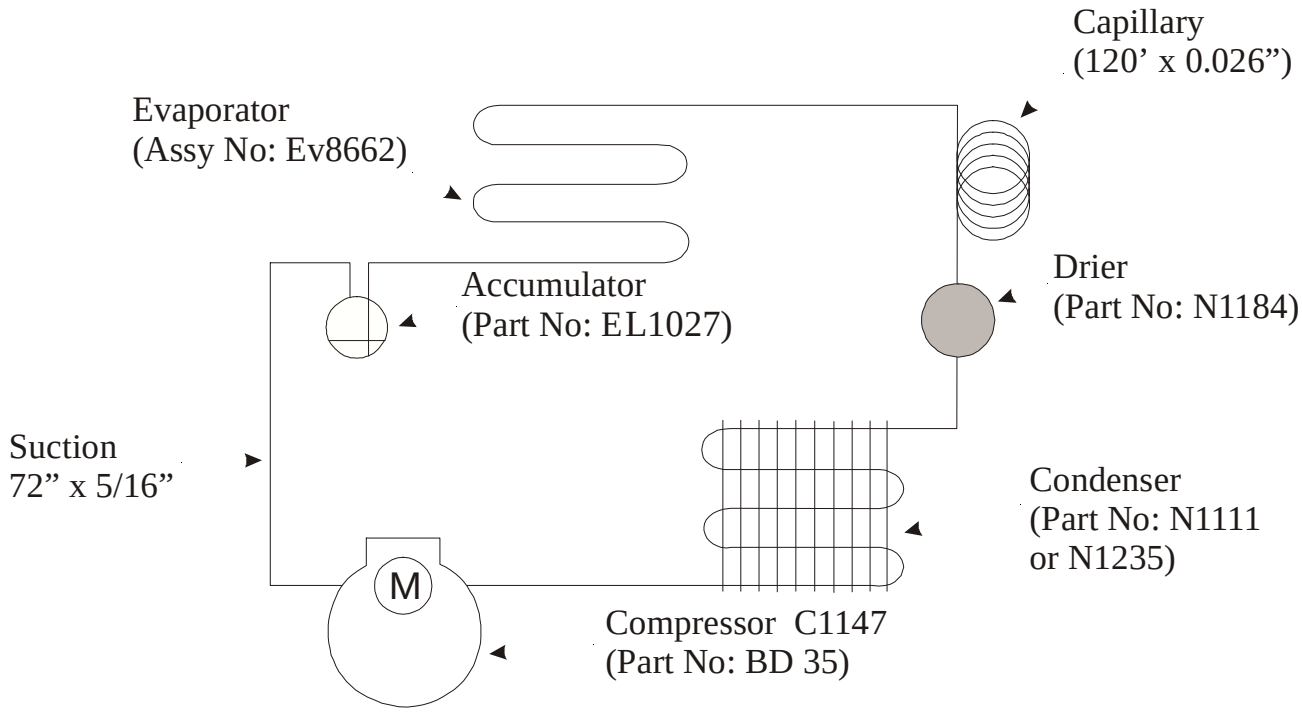
Compressors C1147	BD 35
Compressor Controllers	101N0210
Thermostats	AT-5BQ8L-1PS
Switch on Freezer only	CV465
Fan	E2076

REFRIGERATION CIRCUIT DIAGRAM

VC150 REFRIGERATOR



VC150 FREEZER



For more information contact:

DULAS Ltd, Dyfi Eco Park, Machynlleth, Powys, Wales SY20 8AX

tel: +44(0)1654-705000 fax: +44(0)1654-703000 e-mail: solar@dulas.org.uk

website: www.dulas.org.uk